Rapid Contingency Airfields

Off-the-shelf materials, modified commercial equipment and new engineering systems can get a runway operational in hours or days.

By *Gary Anderton, Ph.D.*

The face of war is changing. New speed goals established by the Department of Defense (DOD) call for the U.S. military to deploy to a distant theater in 10 days, defeat an enemy in 30 days and be ready for an additional fight within another 30 days.

Air power and air logistics are critical to the success of such military operations. Yet U.S. forces typically find themselves in areas where airfields are non-existent, badly damaged by U.S. or enemy gunfire, or suffering from neglect and poor initial construction. Soldiers must be equipped with techniques to rapidly build airfields capable of handling the larger aircraft and sorties needed for force projection. This demands a rapid infusion of technology into the engineering and construction force.

Such is the mission of the Joint Rapid Airfield Construction (JRAC) Program at the U.S. Army Engineer Research and Development Center (ERDC). JRAC technologies address the primary obstacles to rapid airfield construction: inadequate or denied theater airfields; under-strength airfields that support limited traffic; and the large quantities of additives and long material cure times required for traditional soil stabilization as currently practiced.

JRAC research focuses on providing engineering tools and systems to dramatically increase military engineers' capabilities in airfield upgrade and construction. The program uses off-the-shelf materials and modified commercial equipment to prepare a site and make it operational in a matter of hours or days. Key elements of JRAC technologies include performance-based site selection and

The goal of JRAC rapid soil stabilization technology is to take any soil type from any location and rapidly stabilize it so that large aircraft, such as the C-130 and C-17 aircraft used by the Army, can safely operate on that soil. By using rapid stabilization techniques such as fiber-reinforced multi-purpose matting and fiber or polymer with high-early strength cement combinations, what normally took three weeks to accomplish can be done in less than three days.

The JRAC Program also plans to provide a range of options for facility expansion to handle more aircraft, such as parking aprons, which free the runway for additional incoming aircraft.

Putting Theory into Practice

For the JRAC Program's first field demonstration in the summer of 2004, approximately 40 soldiers from the 20th Engineer Brigade, the 307th Engineer Battalion and the 412th Engineer Command worked to construct two parking aprons adjacent to the Sicily Assault Landing Zone airfield at Fort Bragg, N.C.

Soldiers quickly put together a lightweight matting system with simple hand tools.

assessment, enhanced construction and rapid soil stabilization.

Site Selection and Assessment

The JRAC Program's site selection process provides design aids to rank and select contingency airfield sites based on projected engineering effort, mission suitability, pavement design and construction requirements, and airfield performance under traffic.

To optimize site selection, JRAC uses advanced terrain analysis and material performance prediction methods to minimize the engineering effort. Night vision goggles, Global Positioning Satellite (GPS) tools and laptops loaded with geospatial software allow site surveys to be conducted any time, day or night.

JRAC also uses the Rapid Assessment Vehicle Engineer (RAVEN) to gather topographic data. RAVEN is based on the Bobcat Toolcat utility vehicle. It has several implement attachments that can be used on the front of the vehicle and is equipped with the Trimble Real Time Kinematic GPS system that gathers topographic data with very high accuracy (cm level) in a short amount of time. RAVEN can be operated by a user in the cab, by remote control and through autonomous mode, which can be used if an area is deemed too dangerous for soldiers to approach.

Once topographic data is collected, soils are analyzed in the field using a rapid soils assessment kit developed by ERDC. The kit consists of a microwave to determine a soil's moisture content (in five minutes versus 24 hours), tools for sample collection, an electronic balance, and equipment to determine design strength and analyze construction requirements for the area.

Enhanced Construction

Once a site is selected and analyzed, enhanced construction methods, which emphasize rapid construction without sacrificing quality, can be put to use. In this

The soldiers began at midnight of the first day, conducting site surveys and designing, constructing and stabilizing two 40,000-sq-ft parking aprons. The goal was to have the aprons ready for a scheduled landing by C-130 aircraft from nearby Pope Air Force Base on the fourth day.

By mid-morning, the survey and apron designs were complete and the digital topographic information was transferred to the earthmovers for clearing operations. Final site grades were programmed into the equipment so that cut and fill operations could be conducted quickly and effortlessly.

ERDC engineers provided a new apron design to the soldiers as well. Instead of the usual square parking apron, engineers designed a trapezoidal apron that measured 100-ft at the back, 225-ft on its tapered sides, and 300-ft on the front adjacent to the parallel taxiway. This apron design allows the pilot to make a wider, easier 45-degree turn while reducing potential damage to the apron.

The first parking apron was stabilized to a 6-in depth with a combination of polypropylene fibers and high-early strength Portland cement. The other apron had half its surface area stabilized with an emulsion polymer and high-early strength Portland cement combination; the other half was covered with a light-weight, fiberglass-reinforced matting system known as ACE mat. All stabilized soil surfaces were then sprayed with a liquid polymer that formed a tough weatherproof layer and a dust-controlled surface.

Just 75 hours after site surveying began, the parking apron was ready for aircraft. C-130 aircraft taxied onto the parking aprons after several landing operations. The apron designs worked extremely well and the pilots were enthusiastic about the airfield's new capacity to handle up to three aircraft at a time during training exercises.

Future Outlook

The JRAC Program is refining its tools and technologies with a focus on providing

use of GPS topographic surveying equipment. Then, laptop-generated 3-D designs are in turn seamlessly transferred to GPS-controlled earthmoving equipment, such as scrapers and bulldozers with antennae mounted on the blades to control blade height and angle. Enhanced construction also includes the proper use of the air-droppable, smaller soil compactors and a new self-propelled soil pulvermixer to mix various additives into the soil for strengthening. Through the JRAC Program, new compact quality assurance test equipment also is being developed.

A soldier creates digital designs for a new aircraft apron in less than one hour with the RAVEN.

Rapid Soil Stabilization

When an airfield is brought to final grade, its surface must be able to sustain mission-required operations with minimal maintenance. Current stabilization methods use mostly Portland cement or lime, both of which require up to 30 days for curing and large amounts of material.

Photos courtesy ERDC

larger C-17 aircraft. The JRAC Program's planned final demonstration exercise in 2007, marking the completion of the research and development phase, will involve the construction of a C-17 capable contingency airfield in a rapid deployment scenario similar to the 2004 demonstration exercise.

ERDC researchers are on schedule to provide detailed specifications of all tools, materials and systems developed under the JRAC Program so that various U.S. military engineering components can begin fielding JRAC capabilities by 2010.

The JRAC Program ultimately will revolutionize the U.S. military's approach to contingency airfield construction. Modern materials and technologies will provide the means to select the best airfield sites and rapidly construct or upgrade these airfields in hours or days. The JRAC Program will make contingency airfield engineering an asset and a distinct military advantage.

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